

the necessity of making both logarithms and numerical trigonometry compulsory for the university matriculation, because the work of the intermediate classes in the universities was being seriously hampered by the lack of such knowledge on the part of a large number of the students. Prof. Whittaker gave a most interesting paper on "Some Mathematical Problems awaiting Solution," which suggested themselves chiefly in computational work, such as the question of the convergence of certain approximative processes in the case of a large number of simultaneous equations. Mr. R. C. Fawdry opened a discussion on the teaching of mechanics to beginners, and said that, after many years' experience, he still could not decide whether to teach statics or dynamics first. A vigorous protest was entered by Dr. S. Brodetsky, Prof. W. P. Milne, and Mr. A. W. Siddons against the practice that had just arisen of teaching "pure mathematics" in the new advanced courses in secondary schools, thereby promoting undue specialisation at a young age and losing entirely the outlook which a combined course of pure and applied mathematics can supply.

The meetings were extremely well attended and very enthusiastic.

WILLIAM P. MILNE.

INDUSTRIAL RESEARCH ASSOCIATIONS.

THE Department of Scientific and Industrial Research has just issued the following list of research associations which have been approved by the Department as complying with the conditions laid down in the Government scheme for the encouragement of industrial research, and have received licences from the Board of Trade under section 20 of the Companies (Consolidation) Act of 1908:—

British Boot, Shoe, and Allied Trades Research Association, Technical School, Abington Square, Northampton. *Secretary*: Mr. John Blakeman.

British Cotton Industry Research Association, 108 Deansgate, Manchester. *Secretary*: Miss B. Thomas.

British Empire Sugar Research Association, Evelyn House, 62 Oxford Street, London, W.1. *Secretary*: Mr. W. H. Giffard.

British Iron Manufacturers Research Association, Atlantic Chambers, Brazennose Street, Manchester. *Secretary*: Mr. H. S. Knowles.

British Motor and Allied Manufacturers Research Association, 39 St. James's Street, London, S.W.1. *Secretary*: Mr. Horace Wyatt.

British Photographic Research Association, Sicilian House, Southampton Row, London, W.C.1. *Secretary*: Mr. Arthur C. Brookes.

British Portland Cement Research Association, 6 Lloyd's Avenue, London, E.C.3. *Secretary*: Mr. S. G. S. Panisset.

British Research Association for the Woollen and Worsted Industries, Bond Place Chambers, Leeds. *Secretary*: Mr. Arnold Frobisher.

British Scientific Instrument Research Association, 26 Russell Square, W.C.1. *Secretary*: Mr. J. W. Williamson.

British Rubber and Tyre Manufacturers Research Association, c/o Messrs. W. B. Peat and Co., 11 Ironmonger Lane, E.C.2.

The Linen Industry Research Association, 2 Bedford Street, Belfast. *Secretary*: Miss M. K. E. Allen.

Glass Research Association, 7 Seamore Place, W.1. *Secretary*: Mr. E. Quine.

British Cocoa, Chocolate, Sugar Confectionery, and Jam Trades Research Association, 9 Queen Street Place, E.C.4. *Secretary*: Mr. R. M. Leonard.

Schemes for the establishment of research associations in the following industries have reached an advanced state of development:—

Research Associations Approved by the Department but not yet Licensed by the Board of Trade.—British Music Industries Research Association, British Refractory Materials Research Association, British Non-Ferrous Metals Research Association, and Scottish Shale Oil Research Association.

Proposed Research Associations the Memorandum and Articles of Association of which are under Consideration.—British Launderers Research Association, British Electrical and Allied Industries Research Association, and British Aircraft Research Association.

Industrial Organisations Engaged in Preparing Memorandum and Articles of Association.—Silk Manufacturers, Leather Trades, and Master Bakers and Confectioners.

In addition to the industries included above, certain others are engaged in the preliminary consideration of schemes for forming research associations.

THE ORGANISATION OF IMPERIAL STATISTICS.¹

POINTING out that it was almost emphasising the obvious to say that any great nation should be thoroughly informed as to its numerical, its social, and its economic drift, the author directed attention to the fact that this had been recently recognised in a petition to his Majesty's Government so late as November 1 last. It was also emphasised by the calling together of a Conference of the Statisticians of the Empire, under the ægis of the British Government. In view of the position of the British Empire in world affairs, it was but little short of amazing that an Imperial Bureau of Census and Statistics was not long ago established. A bureau, to be really Imperial, must recognise the community of interest of all parts of the Empire. It was not something to be created mainly for the purposes of the United Kingdom, but something which would meet equally well the purposes of each part of the Empire. For this reason the needs of the autonomous Dominions must be quite as carefully considered as those of the United Kingdom itself, and it was implied in the paper that any part of the Empire which could not at present meet the common requirements of the whole must be prepared to do so. The interest would be general only in so far as it was Imperial.

In order to overcome departmental frictions and to secure the sympathy and co-operation of all public departments, it was suggested that a Central Statistical Commission should be created, the president of which would, of course, be the Director of the Bureau of Statistics. Such a Commission would be a body of expert advisers, and could make its departments helpful. The scope of an Imperial Statistical Bureau, both as to administrative procedure and as to subject-matter to be dealt with, was outlined, as was also the question of compilation and publication.

To attempt to organise an Imperial Bureau of Statistics with a small and humbly qualified staff would foredoom it to failure, said the author. In its higher professional section it must necessarily have experts in statistical theory, in the technique of the collection and compilation of statistical data, in pure and applied mathematics, in the languages which are important in the statistical field, in statistical editor-

¹ Abstract of a Paper presented to the Royal Statistical Society on Tuesday, January 20, by G. H. Knibbs, Statistician of the Commonwealth of Australia.

ship, in draughtsmanship and graphical representation, and in the interpretation and explanation of statistical results. In this last field the Director himself would, of course, be the expert *par excellence*, and not a mere administrator. It was also pointed out that to put the whole of the work in the hands of a mere administrator would lead to failure. The staff would, of course, include persons who specially studied demography, trade, production, finance, labour and industrial affairs, shipping, railways, tramways, and transport and communication.

In concluding, the author said that if the United Kingdom, by appropriate effort, were to supplement the efforts of some of the autonomous Dominions, it would be possible to build up a statistical edifice for the whole British Empire which, in meeting the needs of a great people—with its reactions upon the human race—would constitute the bureau a sort of *temple expiatoire* for our remissness in the past. The keynote of the whole paper was that an important duty has been left unfulfilled, and that we must not go on neglecting it, for such a work is needed by publicists and statesmen, and for the general purposes of intelligent criticism and intelligent government.

ITALIAN PAPERS ON RELATIVITY.

DR. ATTILIO PALATINI, of the University of Padova, Italy, dedicates a special paper (*Ac. d. Lincei*, April, 1919), entitled "Traiettorie dinamiche dei sistemi olonomi con tre gradi di libertà," to the investigation of what may shortly be called irreversible systems, *i.e.* systems the Lagrangian function of which contains the velocity (apart from its square) also linearly. The paper is but a generalisation of Birkhoff's investigation on "Dynamical Systems with Two Degrees of Freedom" (*Trans. Amer. Math. Soc.*, vol. xviii., No. 2, 1917) to three degrees of freedom. The result arrived at is that the trajectories of such a system coincide with those of an ordinary system of three particles with appropriate constraints moving in a conservative field of force which spins uniformly about an axis. The analogy with such systems leads Dr. Palatini to take up in a second note, entitled "Moti Einsteiniani stazionari" (*Ist. Veneto*, May 11, 1919), the relativistic problem of what the author proposes to call *stationary* motions, *i.e.* such for which the four-dimensional line-element ds^2 contains non-vanishing, though constant, coefficients g_{11} , g_{22} , g_{33} (coefficients of the mixed, space-time terms, as $dx dt$, etc.). The chief result is again the equivalence to a three particles system in a uniformly revolving conservative system. It strikes one that this result could be read off the ds^2 almost directly. The result concerning the "anisotropic and irreversible" behaviour of energy is again obvious and, physically, of comparatively small interest.

The paper is inspired by Prof. Levi-Civita's recent investigations on *static* Einsteinian motions (*Ac. d. Lincei*, 1917, *et seq.*), for which g_{11} , etc., are permanently zero—elegant investigations, no doubt, but of purely formal interest.

Dr. Palatini's third recent article, "La Teoria di Relatività nel suo sviluppo storico" (*Scientia*, September–October, 1919), which, though not without many happy ideas as to the popular presentation of the "old" (1905) and the new or generalised relativity and gravitation theory, lacks that plasticity and freshness which would be imparted to it by a more intimate contact with existing physical ideas. This absence of contact goes in the present case (concluding section of part i., dedicated to the older theory

of Einstein) even so far as to ignore the numerous and famous experimental proofs of the variability of mass with velocity. The author does not seem ever to have heard of the beautiful experiments of Kaufmann, Bucherer, Hupka, and others which have made the variability of β -particles an almost tangible fact. The second part of the article, devoted to general relativity, has the indisputable positive feature of being very enthusiastic, and gives, no doubt, some general idea of Einstein's newest doctrine. Yet even here one cannot help being surprised at one or two misconceptions, marring the introductory section on the concept of space-curvature, defects the more inexcusable as they emanate from a pure mathematician. Thus on pp. 16–17 we are invited to imagine some practically one-dimensional beings or animalcules living in three kinds of capillary tubes, a straight, a circular, and a hyperbolic one (devices not unfamiliar to any reader of the great Clifford). Having endowed these unfortunate beings with a sufficient amount of intelligence, Dr. Palatini (speaking of the first of them) proceeds to say: "In order to arrive from one to another point of its space, the being would state (*constatare*) that it had to follow the straight road." As if that poor thing had a choice in its one-dimensional abode! Equally misleading is not only the remainder of the history of these fictitious three beings, but also the presentation (p. 18) of our own concepts of the "spazio ambiente" in which we live.

Carlotta Longo gives, in her doctorate dissertation of 1918 (Padova), published in *Nuovo Cimento* (vol. xv., 1918, pp. 191–211), a very attractive and geometrically elegant investigation on the elementary electrostatic law according to Einstein's generalised relativity and gravitation theory. She confines herself to the special but most important case of a radially symmetric electrostatic distribution, and, integrating the field-equations in Prof. Levi-Civita's form adapted to the present case, finds for the electrostatic force a law which differs from Coulomb's inverse square law only in so far as the distance r from the centre of the field is replaced by the curvature radius of the geodesic sphere passing through the point in question. A further result of the investigation is that, in a radially symmetric field at least, there can be electric charge only where "there is also matter," unless it be a point-charge at the centre ($r=0$) itself. This striking result would deserve a more definite and critical enunciation. We are not told what kind of "matter" is meant, while, on the other hand, the energy of an electrostatic field is, for Einstein, also a kind of "matter." Yet another very interesting result is reached at the end of the paper. It relates to the "mechanical" force exerted by an electron, if its usual "electromagnetic mass" is assumed to be not only an inert, but also a gravitating (heavy) mass. The result is that, in addition to the quasi-Newtonian attraction, there is a *repulsion*, which, however, is comparatively small. Thus, for example, at a molecular distance from the centre the repulsion would be only one-hundred-thousandth of the gravitational attraction.

The paper is clearly written, and, being very suggestive, will certainly attract the attention of Einstein's followers. Nevertheless, one cannot help mentioning here that an excellent paper on this subject (which pushes the analytical, if not the geometrical, solution much farther) was published in 1916 by H. Reissner (*Annalen d. Physik*, vol. 1., pp. 106–20). This paper, however, seems to have entirely escaped the notice of the author, whom nobody will fail to congratulate upon her elegant results.

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